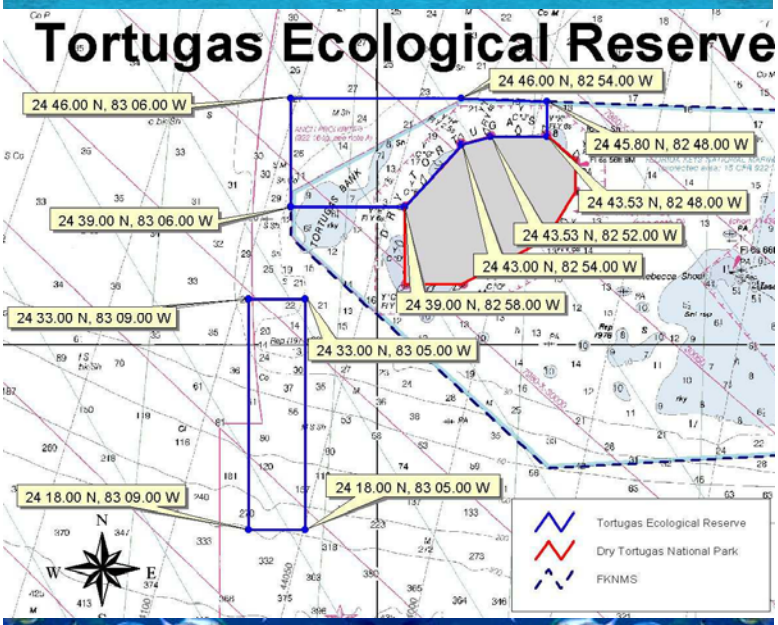
DRAFT WORKPLAN

A BIOGEOGRAPHIC INTEGRATED ASSESSMENT OF THE TORTUGAS ECOLOGICAL RESERVE



A cooperative Investigation by NCCOS (Center for Coastal Monitoring and Assessment Biogeography Team and Center for Coastal Fisheries and Habitat Research), NOS Special Projects Office, NFMS Southeast Fisheries Science Center, Colorado State University, University of Maryland, University of Massachusetts-Amherst (Human Dimensions Research Unit), University of Miami (Rosenstiel School of Marine and Atmospheric Sciences), and Texas A & M University, and in consultation with the National Marine Sanctuaries Program.

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Project Manager: Christopher Jeffrey

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AN INTEGRATED ASSESSMENT OF THE TORTUGAS ECOLOGICAL RESERVE

GOALS

To conduct a biogeographic integrated assessment of reef fishes to determine existing or potential biological, human (societal), and socioeconomic benefits or impacts resulting from implementation of the Tortugas Ecological Reserve (TER).

PROJECT PERIOD: March 1, 2005 to December 31, 2006.

OBJECTIVES

1. Develop the best possible habitat map of the TER based on available data

2. Synthesize and integrate existing ecological reef fish datasets for the TER within a biogeographic framework.

3. Describe biological responses of ecosystem components to the closure of the TER and use biological models derived from U.S. Caribbean reef studies to identify potential biological benefits of the TER to surrounding areas.

4. Develop an approach for including human dimensions research and information within an Integrated Assessment of the TER, review human dimensions research relevant to the TER, and develop a summary document that would be a useful and supporting component of an Integrated Assessment and management of the TER.

5. Assess the availability of data on levels of toxic contaminants, nutrients, and pathogens and determine additional data needs, an appropriate sampling strategy, and how best to incorporate such data into an Integrated Assessment. In a related effort, protocols are currently being developed for determining chemical contaminant gradients in La Parguera, Puerto Rico. If the development of these protocols is successful, recommendations will then be made as to how they could be applied to the TER.

BACKGROUND

Biogeographic Assessment of Reef fish and habitats

The TER is a 391-km^2 no-take area set aside to protect the critical coral reef ecosystem of the Tortugas region, a remote area in the Western Part of the Florida Keys. The reserve consists of two non-contiguous sections: Tortugas North and Tortugas South located about 113 km west of Key West and 225 km from mainland Florida (Figure 1; NOAA, 2000). Because of its upstream oceanographic position, the Tortugas region is considered critical to the functions and dynamics of the wider south Florida coral reef ecosystem, and may be a primary spawning ground for the repopulation of organisms that support fishery production (Lee and Williams, 1999; Ault et al., 2002, 2005). Yet although remote from urban development, the region is still threatened by overfishing and habitat degradation from resource extraction and use in adjacent unprotected waters. A primary goal of the TER is to protect large contiguous diverse habitats to preserve biological diversity, maintain resource quality, and ultimately, to provide

replenishment to adjacent surrounding areas (NOAA, 2000). Coral reef ecosystems are complex biologically and architecturally and vary temporally and spatially. Thus, protection of these habitats and living resources requires a characterization of available habitats and an understanding of the fundamental role of habitats in determining the structure and dynamics of living resources.

Biogeographic analysis is an ideal tool for Sanctuary managers to utilize for conservation of biodiversity and ecosystem integrity across the spectrum of spatial and time scales that these issues encompass (Figure 2). Through a biogeographic analysis, it is possible to predict where, when, and why organism or habitat distributions may change as a result of gradual processes such as slow accumulation of pollutants, to rapid extreme events such as hurricanes (Livingston et al., 2000). Most notably biogeographic approaches are central to the spatial management issues such as those addressed in the Sanctuaries and more specifically, the TER. To properly manage resources, sanctuary staff requires a thorough understanding of resource distribution relative to Sanctuary boundaries. Furthermore, completing a biogeographic assessment of the distribution of resources within and across Sanctuary boundaries is critical for placing them into their wider ecological context and to understand how the composition of the ecosystem changes over time. Coupling simple data layers on animal and habitat distributions with data on human and natural threats provides a powerful predictive tool for Sanctuary managers.

NCCOS and its partners have been developing a suite of biogeographic and ecological databases for the Dry Tortugas and US Caribbean for the past 5 years. Several studies have characterized and mapped benthic habitats, define ecological linkages, define physical oceanographic patterns, and determine the habitat utilization patterns of reef fish (Schmidt et al., 1999; Jeffrey et al., 2001; Burke et al., 2004; Jeffrey, 2004). A complementary body of work is underway at the NMFS SE Fishery Science Center in consultation with the University of Miami (Ault at al., 2001; Ault et al., 2005). Although the myriad of multiple studies have specific objectives and testable hypotheses, no effort is yet underway to integrate the evolving data sets and to conduct targeted field studies to address gaps in data collection for conservation management needs. The effort proposed below would result in an Integrated Assessment of the region based on the principles of biogeography, and also would provide a unique opportunity to examine several potential ecosystem effects within and adjacent to the TER.

The proposed biogeographic assessment study will integrate CCMA, CCFHR, CSCOR, NMFS, and state data into the biogeographic assessment framework developed by CCMA and currently being used and implemented in NOAA National Marine Sanctuaries. This framework will enable organization of existing biogeographic (habitat, biological, and oceanographic) data in comparable and consistent temporal and spatial frameworks to address the objectives listed above.

Assessment of Human Dimensions

The TER has been the focus of much ecological and socioeconomic research on coral reef ecosystems. Much of the socioeconomic research occurred before reserve establishment and focused on some but not all human activities or interests (e.g., Leeworthy et al., 2000, 2004). While this research is substantial, additional work is needed on other aspects of human dimensions research. In addition, the approach (or framework) for incorporating human dimensions information into an overall research package and management understanding, is lacking. This information and approach are necessary components for a complete Integrated Assessment.

The human dimensions project proposed here will expand upon the existing research as summarized to include additional stakeholder groups, and approach the various issues and questions from a broader human dimensions perspective (i.e., include a variety of additional social science disciplines and perspectives). The purpose of this project will be to 1) develop an approach for including human dimensions research and information within an Integrated Assessment for the Dry Tortugas Ecological Reserve, and 2) to conduct a review of the human dimensions research that is relevant to the Dry Tortugas

Ecological Reserve and from that develop a summary document that would be a useful and supporting component of an Integrated Assessment, and the management of the Dry Tortugas Ecological Reserve.

Questions to be addressed by this study include:

1. What habitats in the TER are of known importance to living resources and where are they located? Are there observable spatial patterns in the distribution of these habitats?

2. What are the spatial/temporal patterns in the distribution of fish species and assemblages within the TER? Are particular biological hotspots evident in space and time? Where are suitable habitats for species of particular importance?

3. How can we define bio-physical and connectivity relationships via models of species occurrence or abundance in the TER? Can models of fish community structure created based on fish-habitat relationships in the US Caribbean be used to predict ecosystem responses to closure of the TER?

4. What information on human dimensions research exist and how can such information be used to help guide management of resource use in and around the TER?

5. What work has been done to identify levels of toxic contaminants, nutrients, and pathogens, in the TER, and what additional work is needed to improve our understanding of the role of chemical stressors in this region?

PROJECT TASKS

Below are brief descriptions of major tasks planned for the integrated assessment of the TER.

Task 1. Project Planning and Implementation

This work plan describes the overall project and serves as a blueprint for its implementation. While specific products are identified in this document, the final products are dependent on the quality, quantity, and availability of data for analyses; hence, close collaboration among partners and guidance from ONMS staff will be required.

A meeting among staff from BP, CCFHR, NOS Special Projects Office, and University of Massachusetts held in March 2005 to develop the questions and objectives proposed outlined above. Additional meetings will be held with ONMS staff and project collaborators to ensure the project results will meet the resource management priorities for ONMS, and the most important species, habitat types, and data sets are selected for analyses. Additionally, the spatial domain of the study area must be defined. The consensus among collaborators is to use the Tortugas Ecological Reserve Study Area (TERSA) defined in Leeworthy et al., 2000.

Specific Tasks and Products:

1. Development of a draft implementation plan for review (*In Progress*)
2. A preliminary list of data sets to be used in analyses
3. A preliminary list of deliverables
4. A diagram of the proposed process and schedule for developing a biogeographic assessment.

Lead: Christopher Jeffrey

Task 2. Development of GIS Base (map) Layers for Biogeographic Assessments (obj. #1)

The development of comprehensive benthic habitat, bathymetry, and oceanographic maps will fill current data gaps and also provide base layers for the Integrated Biogeographic Assessment study. Development of robust maps will require an inventory of existing datasets and additional data currently being collected. The primary path for identifying relevant data sets for map development will be via telephone and email surveys with sanctuary staff and regional benthic mapping experts. For example, a map of aggregated bathymetry data assembled by Dave Palandro for South Florida has been sent to CCFHR by Steve Rohman of BP. In addition, the utility of NOS data holdings will be assessed to determine data sets that are relevant to the TER. Ault et al., (2001) list a series of benthic habitat and oceanographic datasets for the TER, which could be used as a starting point for the inventory. The overall accuracy of the final map will be affected by problems associated with the use of different sensors and mapping techniques to characterize the TER across varying geographic scales. Micro-scale habitat data collected by CCFHR and UNC-NURC (Steve Miller's group) could be used for map validation. The ultimate goal is to produce the best habitat map possible based on available data.

Specific Tasks and Products:

1. Development of an oceanographic base map of current flow
2. Development of a habitat base map
3. Development of a bathymetry base map
4. Validation of final map with micro-scale habitat data

Lead: Jerry Ault.

Task 3. Biogeographic Synthesis of Fish-Habitat Relationships (obj. #2)

Collaborators will conduct a series of analyses to model the spatial and temporal distribution of selected fish species and community assemblage metrics to identify key biological areas and time periods based on: species distributions; species life history requirements and habitat affinities; the distribution of habitats; and measures of community structure (e.g., species diversity). Analyses will focus on the CCFHR and Ault-Bohnsack datasets.

Specific Tasks and Products:

1. Summary report on the distribution of selected species among habitats of the TER
2. GIS maps of species distribution biological hotspots (e.g., areas of high biodiversity) in the TER

Leads: Chris Caldow and Jerry Ault.

Task 4. Biogeographic Assessment Models: Assessment of Ecosystem Response (obj. #3)

Fish-habitat relationships developed from **Task #3** will be used to develop models to describe connectivity relationships and to assess or predict potential refugia benefits (e.g., spillover, replenishment) of the TER to surrounding areas. These analyses will attempt to describe spatial patterns in the biological response of ecosystem components to the TER. Additionally, models of fish community structure developed by BP in the US Caribbean will be used to identify or potential biological benefits of the TER.

Specific Tasks and Products:

1. Selection of representative species and community assemblage metrics for spatial modeling
2. Development of spatial models
3. Summary document describing the spatial model and model results

Leads: John Christensen and Jerry Ault

Task 5. Human Dimensions Research (obj. #4)

NCCOS' formal mechanism linking science and management is the Integrated Assessment. As identified in their Strategic Plan, a successful Integrated Assessment will contain the following elements:

1. It will respond to policy relevant questions. As such it is applied in nature.
2. It will identify uncertainties in the existing literature.
3. It will include public participation and peer review.
4. It will integrate data and information across various disciplines.
5. It will use existing data where available and when it is of high quality.
6. It will forecast future conditions.

We will structure our approach to this project in accordance with the above, and thus be consistent in methods and intent with the NCCOS Strategic Plan. Specific methods to be employed will be those found acceptable to the social science professions, and proven to be appropriate for the identified task.

A last and key point is that we expect to work closely with NCCOS personnel throughout the project. As noted above, one of the important elements of an Integrated Assessment is the focus on policy relevant questions. By working closely with NCCOS we will be able to ensure that the science that is produced will meet the needs of the agency and its mission.

Specific Tasks and Products:

We propose a hierarchical approach to the deliverables. Because the amount of existing literature is limited, and because the "framework" for conducting a human dimensions Integrated Assessment does not exist, we will proceed from a ground up perspective that is consistent with the NCCOS Strategic Plan. We will develop and submit the following:

1. An initial draft framework for incorporating human dimensions into an Integrated Assessment for the Dry Tortugas (and for coral reef ecosystems in general). The intent will be for this framework to be useful and applicable in developing future Integrated Assessments for other coral reef ecosystems.
2. Based upon a thorough review of the existing human dimensions literature concerning the Dry Tortugas Ecological Reserve, and coral reef ecosystems, we will identify weaknesses or holes in the literature relative to the Dry Tortugas Ecological Reserve.
3. Based on the above literature review, we will develop an initial human dimensions baseline assessment based on what is currently known about the Dry Tortugas Ecological Reserve. This, in combination with the framework developed in deliverable one above, will also provide guidance in determining what additional information is needed. This is the first step in producing an Integrated Assessment.

Lead: David Loomis

Task 6. Assessment of Toxic Contaminants, Nutrients, and Pathogens

The Dry Tortugas region has experienced impacts from human use (i.e. fishing), but because of its remoteness and relative low level of land use, it may not suffer from high chemical impacts as do reefs in the US Caribbean. Thus, an initial assessment of chemical impacts from human activity in the TER will be in the form of an extensive literature review to assess the availability of data and identify data gaps. If existing research suggests that chemical impacts are a major issue in the TER, then information being collected by CCMA's Chemical Impacts Team (CIT) in a concurrent assessment of chemical impacts in the Puerto Rico will be used to determine how best to incorporate data on chemical stressors in the future. The complementary assessment of potential chemical impacts on the reefs from the Dry Tortugas and US Caribbean will provide an additional metric of reef stress, which will enable an assessment of coral ecosystem status across a continuum of level of stress in each region.

Specific Product: Review of chemical impacts in reefs of the TER.

Leads: Tony Pait and John Christensen

Task 7. Synthesis and Integration of Project Components

Project components will be synthesized and integrated into a final report that will be the "Integrated Assessment" of the TER. The final report will consist of a series of chapters with each chapter summarizing a component or objective addressed by this project.

Specific Product: The final report. A suggested title is "An Integrated Assessment of the Dry Tortugas Ecological Reserve: 2006."

Lead: Christopher Jeffrey

Task 8. Dissemination of Preliminary and Final Products

A project web site will be developed and will be the primary tool for dissemination of preliminary and final products developed from this project. Hard copies of reports, maps and other documents will also be produced as needed by project participants for the public.

Specific Product: A project web site

Lead: Tom McGrath

SCHEDULE

The project is planned for completion by December 31, 2006. Thus, the goal is to have the final product disseminated to the public by the project's ending date. Figure 3 shows a proposed schedule, but a more detailed project schedule will be developed based on input from all project partners.

PROJECT PERSONNEL

CCMA Biogeography Team:
Mark Monaco (Team Leader, Co-PI)
Chris Jeffrey (Project Manager)
Chris Caldow, John Christensen, Steve Rohman., Tom McGrath, and Tony Pait

CCFHR Staff:
Mark Fonseca (Team leader, Co-PI)
Christine Addison, John Burke, Don Field, Jud Kenworthy, Amit Malhotra, Vanessa Nero, Amy Uhrin, Shay Viehman, and Lisa Wood

Other Project Participants:

Human Dimensions Research:

David Loomis (University of Massachusetts-Amherst)
Robert B. Ditton (Texas A&M University)
Doug Lipton (University of Maryland)
Jerry Vaske (Colorado State University)
Bob Leeworthy (NOS Special Projects Office)

Reef fishes and Habitat Research:

Jerry Ault, Jiangang Luo, and Steve Smith (University of Miami, FL)
James Bohnsack (National Marine Fisheries Service)
Billy Cause and Brian Keller (Florida Keys National Marine Sanctuary)
Steven Miller (UNC-Wilmington-NURC)

Additionally, staff of the ONMS (especially FKNMS staff) will be consulted regularly for project review and data identification, collection, and synthesis. Interim products will be offered for review at several points during the project in addition to those noted in this task list. Collaboration with sanctuary research staff is essential to ensure that deliverables will meet ONMS expectations.

PRIMARY CONTACTS

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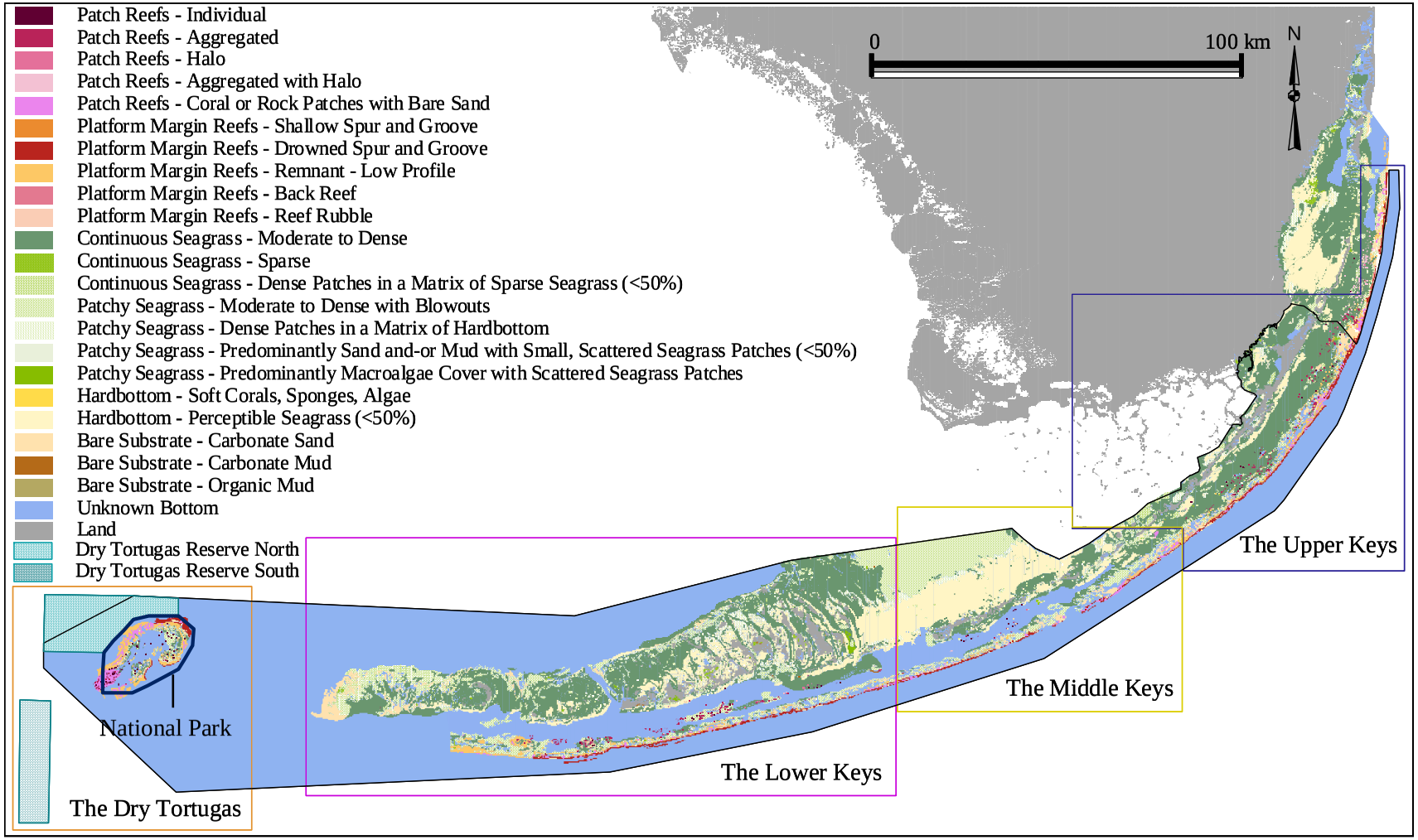
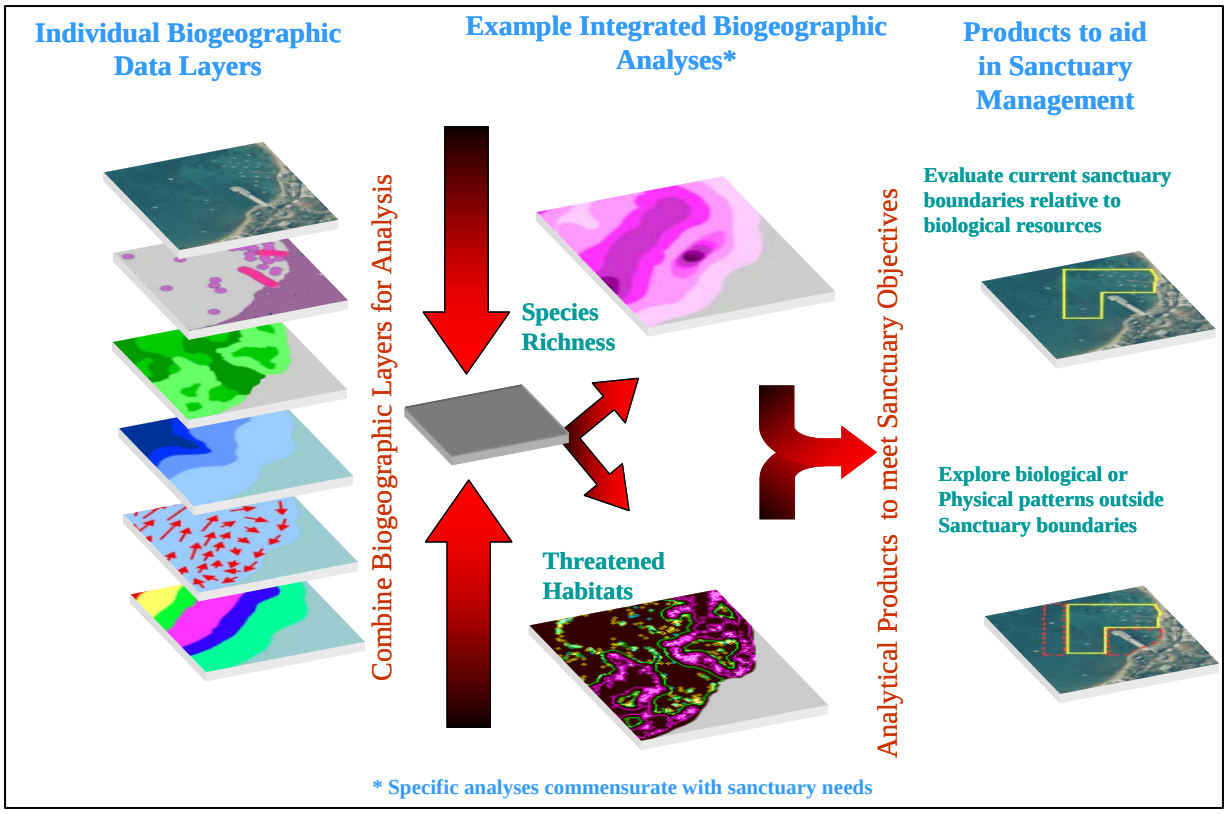


Figure 1. Map of benthic habitats, regions, and management jurisdictions occurring in South Florida (FMRI and NOAA 1998).

Figure 2. What Can a Biogeographic Approach do for Sanctuaries?



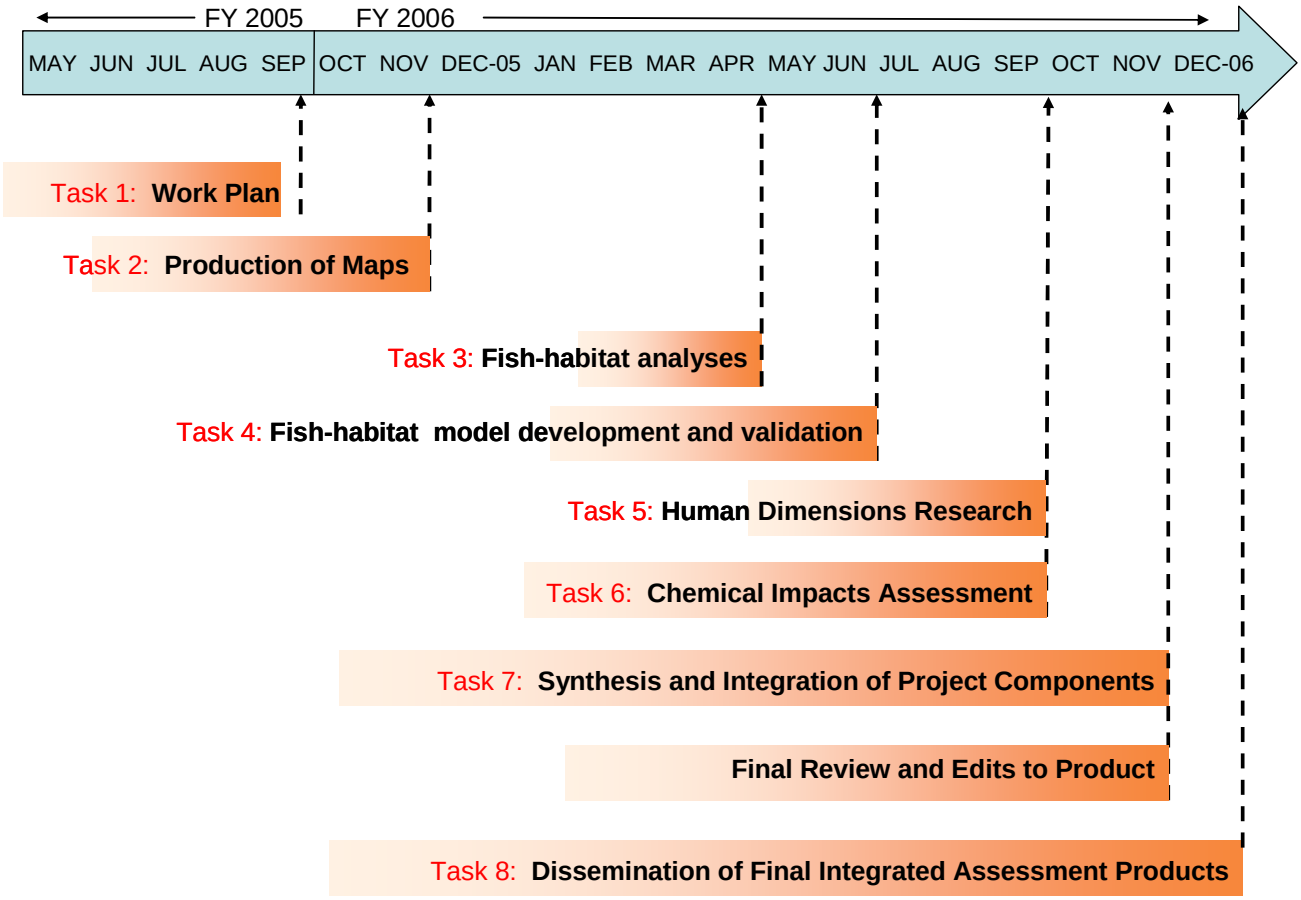


Figure 3. Schedule for completing components of the Integrated Assessment of the Tortugas Ecological Reserve.